



University of Technology, Sydney

**Development of a Lean Six Sigma Implementation  
Framework for Small and Medium Sized Indonesian  
Manufacturing Enterprises**

**By**

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A thesis submitted to fulfillment of the requirements  
for the degree of Doctor of Philosophy

**Faculty of Engineering and Information Technology  
University of Technology, Sydney  
Australia**

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# Certificate of Authorship/Originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated and referenced in the thesis.

Signature of Candidate



I dedicate this thesis to my beloved parents:

Fatmah Ashiblie and Khalid Amar

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## **List of Publications Resulting from this Research**

Amar, K. & Davis, D. (2007), "Evaluating Six Sigma in the Indonesian SME Context", published in the Proceedings of the 5<sup>th</sup> ANZAM and 1<sup>st</sup> Asian Pacific Operations Management Symposium, 6-7 June, Melbourne.

Amar, K. & Davis, D. (2008), "A Review of Six Sigma Implementation Frameworks and Related Literature", published in the Proceedings of the IAENG: International Conference on Industrial Engineering, 19-21 March, Hong Kong.

Amar, K. & Davis, D. (2008), "Are Indonesian SMEs Prepared for Lean Six Sigma?", published in the Proceedings of the 13<sup>th</sup> International Conference on ISO 9000 and TQM, 24-26 March, Kuala Lumpur.

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## Glossary

|             |   |
|-------------|---|
| ABS         | Australian Bureau of Statistics                                 |
| ASEAN       | Association of South East Asian Nations                         |
| BDS         | Business Development Services                                   |
| BPR         | Business Process Re-engineering                                 |
| BPS         | Central Bureau of Statistics                                    |
| BSN         | National Standardization Agency of Indonesia                    |
| CSF         | Critical Success Factors  |
| CTQ         | Critical to Quality   |
| DMAIC       | Define-Measure-Analyse-Improve-Control                          |
| DOE         | Design of Experiments   |
| FAZAT       | Research and Training Center for Labour and Technology<br>Steyr |
| FFF         | Austrian Industrial Research Promotion Fund                     |
| Five S (5S) | Seiri, Seiton, Seiso, Seiketsu, Shitsuke                        |
| FMEA        | Failure Mode and Effect Analysis                                |
| GB          | Green Belt  |
| IDB         | Islamic Development Bank  |
| IFC         | International Finance Corporation                               |
| IPO         | Input-Process-Output  |
| ISO 9000    | International Standards Organisation                            |
| IT          | Information Technology  |
| JICA        | Japan International Cooperation Agency                          |
| JIT         | Just In Time  |
| LIK-UPT     | Centre for Small Industry                                       |
| LSS         | Lean Six Sigma  |
| MBB         | Master Black Belt   |
| MBNQA       | Malcolm Baldrige National Quality Award                         |
| MITI        | Ministry of Industry and Trade of Japan                         |
| MSA         | Measurement System Evaluation                                   |

|        |   |
|--------|---|
| NIES   | National Industry Extension Service               |
| P3ED   | Regional Export Training and Promotion Center     |
| PPM    | Part per Million                                  |
| PUPUK  | Association for the Advancement of Small Business |
| QCC    | Quality Control Circle                            |
| QM     | Quality Management                                |
| ROA    | Return on Assets                                  |
| ROE    | Return on Equity                                  |
| SCM    | Supply Chain Management                           |
| SIPOC  | Supplier-Inputs-Process-Outputs-Customers         |
| SME    | Small and Medium Enterprise                       |
| SMED   | Single Minute Exchange of Dies                    |
| SMIs   | Small and Medium Industries                       |
| SENADA | Indonesia Competitiveness Program                 |
| SNI    | Standard National of Indonesia                    |
| SPC    | Statistical Process Control                       |
| SQC    | Statistical Quality Control                       |
| STM    | Vocational High School                            |
| STEP   | Shell Technology Enterprise Programme             |
| SWP    | Software Park Hagenberg                           |
| TPM    | Total Productive Maintenance                      |
| TQM    | Total Quality Management                          |
| UIN    | Universitas Islam Negeri                          |
| UTS    | University of Technology, Sydney                  |
| VIF    | Variance Inflation Factors                        |

## **Abstract**

The main objective of this research was to develop an implementation framework for the introduction of the Lean Six Sigma improvement approach into small and medium enterprises (SMEs) in Indonesia. It was expected that an appropriate diffusion of Lean Six Sigma would assist the SMEs to improve their competitiveness.

The research involved a close examination of Indonesian SMEs and their support networks in order to evaluate the suitability of the Lean Six Sigma approach and to inform the design of an effective implementation framework.

Six Sigma is a popular business improvement approach. In Lean Six Sigma ideas from Lean Production (Womack, Jones and Ross 1984) have been incorporated with Six Sigma. There is some evidence that Lean Six Sigma has advantages over Six Sigma and provides a strengthened business improvement approach.

Rogers' diffusion of innovations theory is used as the theoretical framework for the research (Rogers 2003). The theory is particularly useful in guiding the diffusion of an innovation developed in one cultural setting into a different cultural setting.

The literature review covers the history and development of Six Sigma and Lean Six Sigma. Also, related approaches such as TQM and ISO 9000 are reviewed. A number of existing Six Sigma implementation frameworks were found in the literature and reviewed.

A review of Rogers' diffusion of innovations theory was undertaken. Also research identifying critical success factors (CSFs) associated with the implementation of improvement approaches such as TQM was undertaken. Rogers' theory and the CSFs literature were important inputs in the research methodology.



Literature on SMEs in general and Indonesian SMEs in particular was reviewed. The contribution of SMEs to the Indonesian economy, the various forms of support available to them and the stage of development of improvement programs was reviewed.

The majority of data were collected through the development and administration of a questionnaire survey completed by SME owners/managers. A sample of 148 usable questionnaires was obtained. Interviews were also conducted with SME owners/managers and other stakeholders e.g., government, Business Development Services (BDS), universities, customers and suppliers.

The results showed that SMEs had a relatively low usage of improvement tools and Information Technology (IT). This low technical base presents a challenge to the successful implementation of Lean Six Sigma. However, owners/managers were relatively optimistic about the success of such an innovation and reported encouraging levels of commitment both by themselves and their employees for such change.

The results established that SME owners/managers were most influenced by their key customers and other SMEs when making decisions about adopting an innovation. The results indicated a preference for face-to-face rather than virtual (online) training. Areas for improvement in the support provided to SMEs from government were reported.

The main outcome of this research is an implementation framework of Lean Six Sigma for SMEs. The frameworks' elements are owner/manager commitment and involvement, training, employee involvement, culture change and external support. The framework is designed specifically for the Indonesian SMEs context and includes the element 'external support' which is not present in any of the existing frameworks that were reviewed.